Francesco Maria Angelici
Lorenzo Rossi *Editors*

Problematic Wildlife II

New Conservation and Management Challenges in the Human-Wildlife Interactions

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Chapter 12
Extinct or Perhaps Surviving Relict Populations of Big Cats: Their Controversial Stories and Implications for Conservation

Lorenzo Rossi, Carmelo Maria Scuzzarella, and Francesco Maria Angelici

12.1 Introduction

The impact of modern humans (*Homo sapiens*) on wildlife has increased in historical times with the advent of the industrial era (Zalasiewicz et al. 2010), but our species has always had a negative effect on many animal populations (e.g., Braje and Erlandson 2013).

Several carnivorous species suffered strong demographic loss, such as the gray wolf *(Canis lupus*), once the most widespread mammal in Eurasia and North America (Boitani et al. 2018). All species of the genus *Ursus* also had a decline in North America, Europe, and Asia, disappearing from North Africa (McLellan et al. 2017).

Among the predators that suffered the impact of human, there are the big cats, mainly afferent to the genus *Panthera* (e.g., Dinerstein et al. 2007; Bauer et al. 2015; Jacobson et al. 2016).

These animals have always represented for human beings not only competitors but also species of great emotional impact. In fact, they appear in prehistoric art (e.g., Bar-Oz and Lev-Yadun 2012; Killin 2013), in ancient folklore (e.g., Ge 2007), religion (Benson 1998), and heraldry (Ross 2006) as symbols of strength and pride.

Some species have also been the focus of recreational (and sometimes controversial) activities in the past and present such as ancient games in arenas (Lindstrøm 2010), big game hunting (Storey 1991), ecotourism (Mossaz et al. 2015), and circus

L. Rossi (✉)
Museo dell'Ecologia di Cesena, Cesena, FC, Italy
e-mail: info@associazioneorango.com

C. M. Scuzzarella
Università di Parma, Facoltà di Scienze Politiche e delle relazioni internazionali, Parma, Italy

F. M. Angelici
Fondazione Italiana per la Zoologia dei Vertebrati (FIZV), Rome, Italy

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shows (Tait 2009) and as attractions for the public in the modern zoos (Bashaw and Maple 2010). Even today they are still the focus of modern urban legends (e.g., Goss 1992; Hurn 2009).

Currently the species of the genus *Panthera* have legal protection in the states where they are present in the wild, with very few exceptions such as South Africa, Namibia, Zambia, Ecuador, and French Guiana, where it is possible to hunt these felids, in a controlled manner, in some private or state areas, or even throughout the national territory (e.g., Silvius et al. 2004). Many conservation plans were initiated in the second half of the last century (Nowell and Jackson 1996), and thanks to this, in some areas, the populations are now stable or even increasing, but their future remains uncertain (Meena et al. 2014; Jhala et al. 2019).

The historical range of the tiger *(Panthera tigris)* once covered an area from Turkey to the east coast of Russia, but today it has decreased by 93% and the populations are highly fragmented (Natesh et al. 2017). Currently it is the most threatened large felid and its habitat has declined due to forestry, agriculture, and oil palm plantations (Hunter 2015). The species is also under intense threat from illegal hunting due to the direct demands of traditional Chinese medicine and increased bushmeat trafficking in Southeast Asia, which has led to a decrease in its prey.

Three subspecies are traditionally recognized to be extinct, the Javan tiger *(Panthera tigris sondaica)*, the Bali tiger *(P. t. balica)*, and the Caspian tiger *(P. t. virgata)*. The latter is now being considered the same subspecies as the Amur tiger *(P. t. altaica)* (see Driscoll et al. 2009). A fourth subspecies, the southern Chinese tiger *(P. t. amoyensis)*, has experienced a huge decline (Tilson et al. 2004) and is extinct in the wild (Hunter 2015).

Even the lion *(Panthera leo)* suffered an impressive demographic decline: over the last century, it has lost about 82% of its former distribution range (see Trinkel and Angelici 2016). Currently the largest population lives in eastern and southern Africa, while the species has declined in Central Africa and become extinct in most of West Africa (Henschel et al. 2014). It is also extinct throughout the Middle East and Asia, with the exception of the Indian population, consisting of approximately 650 individuals, although currently growing (Singh and Gibson 2011; Singh 2017; Kaushik 2017). The decline of the African lion is mainly due to the extensive loss of habitat and prey due to agriculture and cattle breeding, but also to direct persecution and poaching on potential prey (e.g., Trinkel and Angelici 2016).

In historical times, the Cape lion (*Panthera leo melanochaita*) and the Barbary lion (*Panthera leo leo*) become extinct. These populations are now considered part of the new taxonomy of southern and northern subspecies (Black 2016; Bertola et al. 2016).

The leopard *(Panthera pardus)* is the felid with the largest natural range (Jacobson et al. 2016) and the most varied diet (Hayward et al. 2006). Despite its extreme plasticity that allows it to survive in a wide variety of different environments (e.g., Nowell and Jackson 1996), and its surprising tolerance to human activities (Hunter 2015), the decline of its populations is compatible with that of the other large carnivores (Ripple et al. 2014). Currently the species occupies 25% to 35% of

its historical range (Jacobson et al. 2016). The survival of the species is threatened by the loss of habitats and prey and by the persecution to which it is subjected in grazing areas. The leopard is also hunted for the skin and for the parts sold in the trafficking of traditional Asian medicine (Hunter 2015).

Despite the fact that the jaguar *(Panthera onca)* is the only species of the genus *Panthera* not considered "endangered" or "vulnerable" by the IUCN (its actual status is "NT"), since 1900 its historical range decreased from 19,000,000 to 9,000,000 km^2 (Seymour 1989), and this big cat is now considered extinct in the USA – but in recent years there has been sporadic sightings in Arizona and New Mexico (see Brown and Gonzalez 2000) and Uruguay and El Salvador (Hunter 2015). Furthermore, assessments of the conservation status of the species have indicated a decline in its current range (Sanderson et al. 2002).

Even the snow leopard *(Panthera uncia)*, despite being perceived as an animal living in remote and inhospitable areas, has frequent interactions with human and his activities (e.g., Hussain 2003; Bagchi and Mishra 2006). Also the populations of this species are in decline (McCarthy and Chapron 2003), and among the threats there is climate change (Forrest et al. 2012) and the loss of prey species (Namgail et al. 2007).

The purpose of this work is to summarize the information available on some populations and subspecies, mainly of the genus *Panthera*, extinct or considered extinct in historical times. We identify common features in these extinctions of big cat subspecies and significant populations, in terms of patterns of conservation importance and risk of biodiversity loss (i.e., unique taxa, genetics, etc.) and impact on ecosystem balance. Some historical pictures, often representing the last available visual documents of some very rare or already extinct subspecies, have also been collected.

Currently there are different viewpoints on the systematics of the genus *Panthera* with regard to the subspecies (see Kitchener et al. 2017), but in this work we have decided to adhere more to the previous approach (Wozencraft 2005), in particular to underline the importance of the concept of subpopulations and local extinction with regard to conservation.

12.2 Case Studies

*12.2.1 Cape Lion (*Panthera leo melanochaita *Smith, 1842) EX*

The Cape lion (Fig. 12.1) inhabited the western part of the Cape Province of South Africa. It was the first *taxon* of the genus *Panthera* to be extirpated in historical time and the one with the least information available. Smith (1842) described it as a large subspecies with ears edged with black and a thick black mane that covered also the shoulders and the belly. Some lions killed near the Vaal River reached weights of

Fig. 12.1 A Cape lion at the Jardin du Plantes, Paris, 1860. (Public domain)

about 272 kg, a size comparable to that of the Barbary lion that populated North Africa (Pease 1913). Its extinction followed soon after the arrival of the European settlers, making the subsequent destruction of the habitats an irrelevant factor (Day 1981). In fact, the population was exterminated because it was considered harmful to livestock (Haagner 1920). The last known specimen was hunted down and killed by General J. Bisset in Natal (now KwaZulu-Natal), in 1865 (Day 1981). Actually only a few skeletal remains and stuffed specimen are known and stored in museums (Christiansen 2008).

*12.2.2 Barbary Lion (***Panthera leo leo** *Linnaeus, 1758) EX*

The Barbary lion (Fig. 12.2) was formerly widespread in Mediterranean Africa (Guggisberg 1963). Thousands of years ago, the Barbary lion inhabited the whole area of the present Sahara desert, once characterized by a savannah similar to that of today's East Africa. Males could reach a length of 3.5 m and a weight of 280–300 kg. The mane was black and abundantly developed around the head, neck, and shoulders and under the belly (Day 1981).

Its decline began with the desertification that started in the second millennium BC. This reduction of the range lead to three isolated subpopulations: one on the Atlas mountains between Morocco and Algeria, one in the Nile delta, and one in the Nubia mountains (Pease 1899).

Fig. 12.2 Male Barbary lion at Lincoln Park Zoo, New York, 1900. (The Field Museum Library)

The Roman conquest of North Africa further decreased the lion population: thousands of specimens were captured and imported every year for games in the arenas (Pease 1899), but the populations started to seriously dwindle in Libya by the late 1700s.

Deprived of its main habitat and prey, the Barbary lion began to feed on domestic livestock, which thus contributed to its persecution. The subsequent introduction of firearms significantly accelerated its demographic decline (Guggisberg 1963): in Algeria, lions were numerous enough for a bounty to be issued by the French colonial government (see Yamaguchi and Haddane 2002).

Between 1500 and 1700, lions were still reported in the northern Moroccan coast, and until 1830 they were still spotted on the Rif mountains and in the Mamora forest (Guggisberg 1963), but from 1880 they began to retreat on the Atlas chain and in the Saharan regions, where there was less human pressure (Cabrera 1932). Lions from Morocco survived in captivity for a certain time before the extinction in nature due to the custom of the sultans to keep specimens in the gardens of the palace in Fez. In fact, for centuries, lion cubs were offered by tribes from the Atlas mountains as tributes. In the late 1960s, to improve life for the lions, a new enclosure (which in 1973 will become the Rabat zoo) was built in Tamara (Yamaguchi and Haddane 2002).

The last lion of the Rif was killed in 1895 (Lavauden 1932), and in 1925 a male was photographed by an airplane who was flying on the Casablanca-Dakar route

(Black et al. 2013). In 1930 some footprints were found in the area of Ouiouane (Morocco), and in the summer of the same year, some lions were observed at an altitude of 3000 m on the Toubkal massif (Panouse 1957).

In 1942 a male was shot on the Tizi-N'Tichka pass, High Atlas: it was the last confirmed individual in Morocco (Guggisberg 1963). In Tunisia the last lion was shot in 1891 and rumors about the presence of the species in the Khmir mountains and near Feriana continued until the early 1900s (Guggisberg 1963). In Algeria, the last lion of the Saharan Atlas was killed around 1920 (Yamaguchi and Haddane 2002).

Another individual was shot in 1943: it was the last Barbary lion confirmed in nature (Yamaguchi and Haddane 2002). The last known sighting of a Barbary lion, however, took place in 1956 in Algeria: passengers on a bus claimed to have observed one in a forest (Haddadou 1994).

On the basis of a mathematical model, Black et al. (2013) hypothesize that small populations of lions survived until the early 1960s in Algeria (later eradicated by the Franco-Algerian war) and probably until the 1960s in remote areas of Morocco.

12.3 Tiger (*Panthera tigris*)

*12.3.1 Bali Tiger (*Panthera tigris balica *Schwarz, 1912) EX*

The Bali tiger (Fig. 12.3), the smallest subspecies of tiger, was the first to become extinct. The largest males were 220–230 cm long and weighed a maximum of 90–100 kg (Mazak 1981).

Its skull was similar in size to that of the Javan tiger *(Panthera tigris sondaica)* but with more marked zygomatic arches, and the hair was short and bright orange, with fewer black stripes than other subspecies (Schwarz 1912).

The Bali tiger lived on the Indonesian island of the same name. Because of the small size of the territory (5780 km^2), it is very likely that this tiger was never numerous, another factor that probably contributed to its rapid extinction.

In the late nineteenth century, rice and oil palm crops developed a great deal, taking advantage of the rich volcanic soil and the alluvial plain along the perimeter of the island (Seidensticker 1986). Tigers were hunted and shot for sport. The kills perpetrated by Western hunters and the disappearance of its habitat and its prey led to the extinction of the species.

On September 27, 1937, an adult female was killed in the western region of Bali: it was the last individual known in nature (Day 1981).

Based on unconfirmed reports, Seidensticker (1986) believes that some tigers could have survived until the 1940s and maybe until the 1950s. The last alleged sightings were reported in 1970 and in 1972 in the western region of the island (Maas 2010).

Fig. 12.3 Bali tigers at the Ringling Bros circus, USA, circa 1915. (Harry A. Atwell 1915)

*12.3.2 Javan Tiger (*Panthera tigris sondaica *Temminck, 1884) EX*

The Javan tiger (Fig. 12.4) was a subspecies native to the Indonesian island of Java. It was one of three island subspecies, together with the Sumatran tiger *(P. t. sumatrae)* in danger of extinction, and the Bali tiger (extinct), all originating from the Sunda Islands.

Its size was between that of the Sumatran tiger and the Bali tiger, but the color was much lighter and faded into yellow. Its footprints were larger than those of the

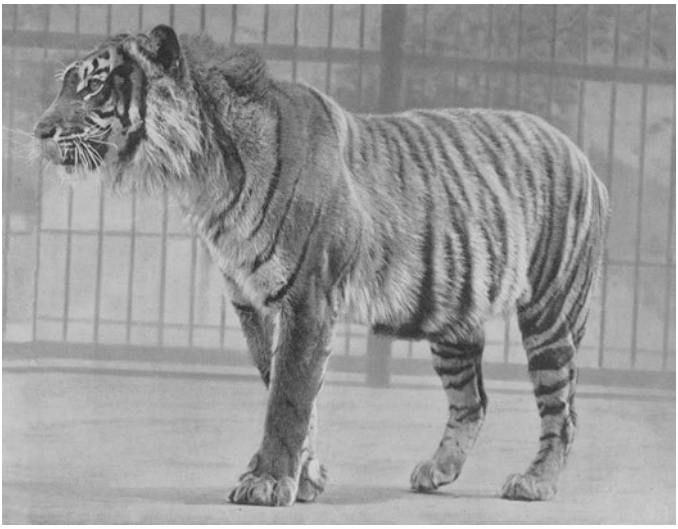

Fig. 12.4 Javan tiger at London Zoo, 1942. (F.W. Bond)

Fig. 12.5 Female tiger killed at Besuki, Java, 1934. (Public domain)

Bengal tiger *(P.t. tigris)*, most likely an adaptation to the mud and soft ground of the tropical forest (Seidensticker 1986).

Once widespread throughout the island, until 1850 it was still so numerous that it was considered a pest by the population (Figs. 12.5 and 12.6), but since 1940 it survived only in the most remote mountain forests (Seidensticker 1987). In 1970 the

Fig. 12.6 Tiger killed in Malingping, Banten province, western Java region, 1941. (Public domain)

only known tigers were believed to live exclusively on Mount Betiri, in the eastern end of Java: the area was declared a nature reserve in 1972, and in 1976 the last tigers were observed inside it (Seidensticker 1987).

The factors that led to the extinction of the Javan tiger were the same as the Bali tiger: a growing human population that destroyed forests by replacing them with crops and rarefying its main prey. In Java, forest cover fell from 23% in 1938 to 8% in 1975 (Seidensticker 1987).

In addition, several epidemics exterminated populations of maned sambar *(Rusa timorensis)*, the main prey of the Javan tiger, and the villagers began to attract the tigers with poisoned morsels to protect the crops (Seidensticker 1987).

After the period of civil unrest in 1965, several armed groups withdrew to the forests where they killed the last remaining tigers (Seidensticker 1987). In 1971 an old female was killed in a plantation near Mount Betiri (Seidensticker and Suyono 1980).

No offsprings have been sighted in the area since then. In 1976, on the basis of footprints, 3–5 tigers were estimated to exist in the eastern part of the reserve of Meru Betiri (Seidensticker and Suyono 1980).

Since 1979 no tiger has been sighted in Meru Betiri, but in 1987 a survey conducted by 30 students of the Agricultural University of Bogor (Java) found alleged scats and footprints (Istiadi et al. 1991).

In the western part of the island, the last confirmed shooting of a Javan tiger took place: in 1984 a tiger was killed in the Halimun nature reserve (now a national park

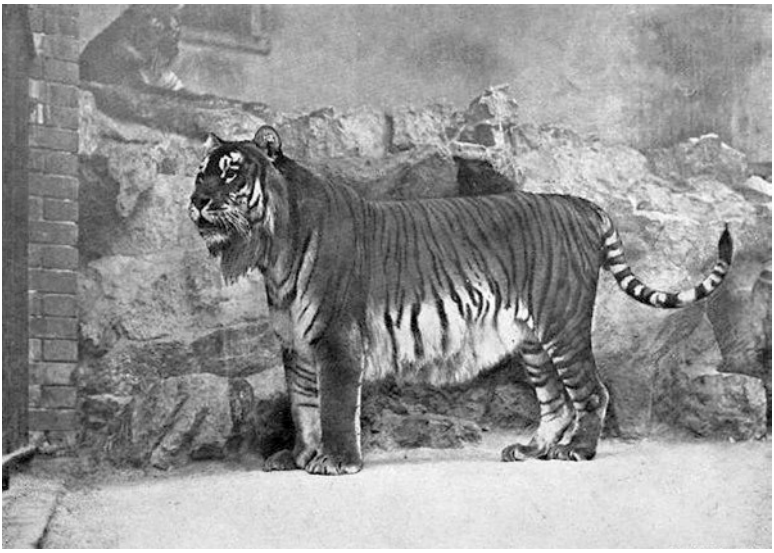

Fig. 12.7 Caspian tiger, Berlin Zoo, 1899. (Public domain)

of Mount Halimun Salak), and in the same area in 1989, alleged footprints were found, but a survey conducted in 1990 did not find any tiger (Istiadi et al. 1991). Further surveys were carried out between 1992 and 1994 in Meru Betiri, using camera traps, but no data were collected (Rafiastanto 1994). So, the Javan tiger was declared extinct (Kemf and Jackson 1994).

A further attempt made in 1999 again in Meru Betiri, with the help of the staff of the Sumatran Tiger project, failed in its intent (Tilson 1999).

*12.3.3 Caspian Tiger (***Panthera tigris virgata** *Illiger, 1815) Probably EX*

Once widespread from western Anatolia to the western regions of China and Mongolia, the Caspian tiger (Fig. 12.7) was among the largest: the maximum weight recorded in nature was 240 kg, and a tiger killed in the valley of the river Sumbar (mountains Kopet-Dag, Turkmenistan) in January 1954 had a skull length of 385 mm, larger than the average of Amur tigers (Heptner and Sludskii 1972).

The distribution of the Caspian tiger was associated with rivers, swamps, and lakes where the riparian forest offered cover to itself and its prey (Heptner and Sludskii 1972). The first hard blow to the population of Caspian tigers was inflicted by the Romans, who brought back thousands of individuals from Anatolia and the Caucasus for games in the arenas of the Empire: stone traps for tigers and leopards are still visible on the mountains of Taurus in Turkey (Şekercioğlu et al. 2011).

This caused the extirpation of the Caspian tiger from a large part of the Anatolian peninsula, but the most impactful factor was the colonization of Central Asia by Tsarist Russia at the end of the nineteenth century when the tiger's hunting grounds were converted into cotton fields and an intense campaign of persecution took place. Until the First World War between the Amu-Darja and Pjandi rivers, about 50 tigers were killed every year (Prokhorov 2002). At the beginning of the twentieth century, a tiger skin could be sold for between 1500 and 2500 rubles, while, for example, a snow leopard skin was worth only 300–500 rubles (Prokhorov 2002).

The strong demand for tiger bones and parts for use in traditional Chinese medicine also encouraged hunting (Heptner and Sludskii 1972; Prokhorov 2002). The Russian army was also employed in the fight against animals considered harmful, and for each killed tiger, a large bounty was given until 1929 (Jungius et al. 2009).

Large swamps and rivers in Central Asia were infested with malaria and therefore not populated, providing a safe area for the tigers, but in the 1930s malaria was eradicated which lead to the colonization of the territories and consequent destruction of habitat for agriculture (Jungius et al. 2009).

In the meantime due to intense agricultural development, especially in the Fergana valley (eastern Uzbekistan, southern Kyrgyzstan, and northern Tajikistan), large portions of the wild territories were converted into cotton fields and farms. Several roads were built and the consequent water exploitation (with the construction of numerous canals that drew water from the Syr-Darya and the Amu-Darya, which started the inesorable decline of the Aral Lake) caused a desertification that fragmented furthermore the tiger's habitat into smaller and more distant groups (Jungius 2010).

Today only 10% of the ancient habitat of the Caspian tiger remains intact. The excessive hunting of its prey and the consequent attacks on livestock (and sometimes people) forever marked its fate: shepherds, hunters, and soldiers used traps, poison, and firearms to exterminate tigers (Jungius et al. 2009).

The only known tiger in Iraq was killed near Mosul in 1887 (Kock 1990). In western China, the tigers disappeared from the Tarim River basin in the 1920s, due to desertification (Ognev 1935). From the basin of the river Manasi, in the Tien Shan, they were eliminated during the period immediately after 1960 (Heptner and Sludskii 1972).

The last tiger in the Caucasus was killed in 1922 in Georgia, near Tbilisi, after attacking cattle (Ognev 1935). Its stuffed body is now on display at the National Museum of Georgia. In the Amu-Darya delta, tigers were common until the beginning of the twentieth century: in the early 1940s, 12–15 specimens were estimated to be in the area, and the last of them were killed in 1947. Unconfirmed sightings in the same area were reported in 1953, 1955, and 1963 (Heptner and Sludskii 1972).

In Uzbekistan, a tiger was killed near Nukus in 1938, and another was shot near the capital Tashkent in 1942. Yet near Nukus another individual was spotted twice in 1968 (Heptner and Sludskii 1972).

In 1972 a tiger was killed in Uzbekistan: it was probably the last confirmed specimen in the whole of the former Soviet Union (Heptner and Sludskii 1972). It is now exhibited at the State Museum of Karakalpakstan.

In Tajikistan, the last tiger in the Gissar valley was shot in 1938. Four more were shot in 1950 on the Tajik bank of the Pjandi River (Heptner and Sludskii 1972). In 1938 the first protected area of Tajikistan was founded: Tigrovaya Balka ("the old river channel of the tiger" in Russian). The name comes from an event that happened years earlier, when a tiger attacked two Russian army officers riding along a dry river channel.

In the early 1930s, 15–30 individuals were estimated in the reserve, but by the end of the 1940s, the number collapsed to no more than 5 (Heptner and Sludskii 1972). The last tiger in the reserve and probably the last in Tajikistan was observed in 1953. Individuals (probably roaming from neighboring Afghanistan) were reported in 1955, 1957, 1959, 1960, 1962, 1964, and 1967 (Heptner and Sludskii 1972). In the middle course of the Syr-Darya river, tigers disappeared in the mid-1930s. In the lower part of the river's valley, the last tiger was killed in 1933 (Jungius 2010). Individuals from Amu-Darya were seen in 1937 and 1945 and for the last time in the early 1950s (Jungius et al. 2009).

In Iran in the 1930s, the Caspian tiger was still present with hundreds of individuals in the northern part of the country. In 1953 a tiger was killed in the province of Golestan, and another specimen was sighted in the same area in 1958 (Firouz 2005). In 1955 a young female was captured and sent to Hamburg Zoo with a herd of onagers (Humphreys and Kahrom 1995; Firouz 2005). It died in 1960. It was most likely the last Caspian tiger kept in captivity in Europe. In a protected area of the Menkalech peninsula, on the Caspian coast, the last tiger was shot in 1957: in the 1960s, 15–20 individuals were estimated in the area and probably survived until the 1970s (Humphreys and Kahrom 1995, Firouz 2005).

In Turkey two tigers were shot in 1943 near Selcuk (western Anatolia), far from their usual range (Johnson 2002). A tiger was killed near Uludere, in the province of Sirnak, in 1970 (Can 2004). Subsequent investigations discovered that in the Far East of Turkey (Kurdistan) until the mid-1980s, one to eight tigers were killed each year and that they most likely survived until the early 1990s (Can 2004). Further reports continued in the 1990s and 2000s, with villagers and border guards reporting that they had heard roars and had observed a large striped cat with night vision equipment.

The last possible report of the Caspian tiger dates back to 1998 and came from Tajikistan, in the Babatag Mountains (Jungius et al. 2009). In Afghanistan, Soviet soldiers and Soviet border guards reported several times that they had seen tigers during the occupation (from 1979 to 1989) and the same was reported by military staff of the international coalition in 2007 (Jungius et al. 2009). A Kazakh hunter claimed to have seen a female with cubs in the Balkhash Lake region in May 2006 (Jungius et al. 2009; Jungius 2010). However, the sighting remains uncertain and unconfirmed. Very few Caspian tigers are known to have been kept in captivity in recent times. A young domesticated female was given to the Soviet ambassador to Iran in 1924 (Chikin and Tsaruk n.d.) . It died at the Moscow Zoo in 1942. The last Caspian tigers in captivity were killed in Mohammad Reza Pahlavi's personal zoo in 1979, during the Islamic Revolution (Chikin and Tsaruk n.d.).

12.4 Leopard (*Panthera pardus*)

*12.4.1 Anatolian Leopard (*Panthera pardus tulliana *Valenciennes, 1856) EX?*

The Anatolian leopard is native to western Turkey (Valenciennes 1856), and under current taxonomy, it is considered as a Persian leopard subspecies *(P. p. saxicolor)* (Stein et al. 2016).

Anatolian leopards once populated the Aegean regions, the Mediterranean coasts, and the mountain forests of central and western Anatolia. Leopards and other predators were imported in large numbers from Anatolia to Rome and to the various provinces of the Roman Empire for games in the arenas (Kullman 1967). In any case, it did not suffer particularly from human pressure until May 5, 1937, when the first hunting regulations of the newborn Republic of Turkey were passed: leopards, tigers, wolves, and many other animals were declared pests and therefore huntable at any time of the year (Ertüzün and Ergir 2017).

At the same time, intensive rural development began in Asia Minor. Large areas of forest were converted into olive groves and the main prey of the leopard began to be hunted relentlessly (Borner 1977). Deprived of their natural refuge and food source, leopards began to attack domestic livestock, thus completing the vicious circle that ended with felids being shot dead with firearms or poisoned (Borner 1977). In 1942 a cub was found by a shepherd in Urla, near Izmir. The individual, a female dubbed Zoza, was sold to a hunter who let it grow for 9 months and who then donated it to the zoo in Izmir (M. Ertüzün, pers. comm.) (see Fig. 12.8).

Fig. 12.8 Zoza, Izmir zoo, 1946 (Cafer Tayyar Türkmen)

In the 1970s, the Turkish Department for National Fund financed a 2-month survey to investigate the leopard status in western Turkey and collected several anecdotes.

In 1972 two specimens were spotted: one near the village of Catacik (Samandağ province) and the other on Mount Agri. On January 17, 1974, in the village of Bagozu (province of Beypazari, not far from Ankara), an Anatolian leopard attacked a woman who was going to the fields, inflicting several wounds. On the same day, the hunters of the village tracked down and killed the leopard. Also in 1974 a leopard was poisoned between Ikistas and Ketendere and in Samsun-Dag National Park (where a leopard had been spotted in 1972). In January and February 1975, a gamekeeper found alleged footprints, and in the same period, soldiers and road workers reported that they heard roars of leopards and that a horse was been killed in the park, presumably by a leopard. In the Spring of 1975, an individual attacked and killed a cow near the village of Kacanci: the inhabitants shot the leopard, but it managed to escape. In the same year a leopard was killed near Seferler. In the Spring of 1976, several goats were presumably killed by a leopard near the village of Viran: the area was sieved but no sign of the presence of the feline emerged. In the same period, an individual was shot near Asar, and in September of the same year, a mule was most likely killed by a leopard, according to the description of the villagers (Borner 1977; Ertüzün and Ergir 2017).

Surveys carried out recently showed that small populations of leopards still survive: in 1992 two chamois hunters saw a leopard between Yusufeli and Artvin, and in 2007, not far from this area, a leopard was sighted from a Discovery Channel operator (Spassov et al. 2016).

Photographs of a dead male specimen were taken in February 2008 in Cumhuriyet village, Bitlis province (Toyran 2018).

In 2010 a leopard was killed and skinned in the Sirnak Province (Avgan 2013a), and in 2013 another individual was killed in Diyarbakir Province (Avgan 2013b).

In September 2013, Sagdan Baskaya of Forestry Faculty of the Karadeniz Technical University, Trabzon, declared that he had obtained several camera trap pictures of leopards in the province of Trebisonda (northeast of Turkey), but the pictures clearly show feral domestic cats and not big cats (Spassov et al. 2016). Alleged leopard videos were captured by thermal cameras found in a military base in Buzulup and gendarmerie station of Karınca village (Toyran 2018).

*12.4.2 Barbary Leopard (*Panthera pardus panthera, *Schreber 1777) CR-EX?*

Very little is known about the history and the decline of these leopards. Until 1900 they were still quite common and widespread in the forests of cedar, juniper, and Aleppo pine of the Middle and High Atlas (Aulagnier et al. 2015), but already in the first decades of the last century, they disappeared from Algeria, and its strongholds remained in the mountain valleys, gorges, and dense Moroccan forests of the roughest

points of the Atlas, and in the 1950s the population was estimated at 50 individuals (Panouse 1957).

Like other big cats, the Barbary leopard was intensely hunted as a trophy and for livestock losses (see Fig. 12.9). Morocco banned leopard hunting in 1952, but after a population increase (about 100 individuals), from the 1970s onwards, the population has drastically decreased: about ten individuals estimated in the 1980s (Aulagnier and Thévenot 1986) and 2–5 individuals in 1996 (Cuzin 1996).

Considered extinct due to the lack of credible data from 1994 onwards (see Cuzin 2003), almost 20 years later, there remains the possibility that a small population still persists (Purroy Iraizoz 2010).

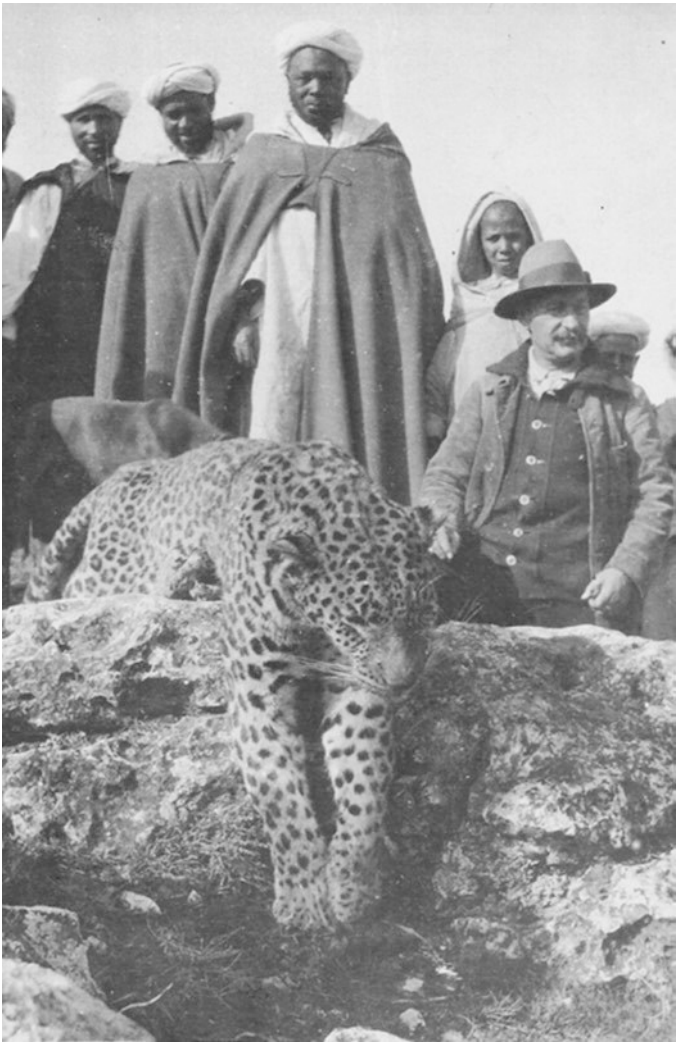

Fig. 12.9 A leopard hunting in Morocco, no data available

*12.4.3 Zanzibar Leopard (*Panthera pardus adersi, *Pocock, 1932) EX?*

Once considered an endemic subspecies of Unguja, the largest island in the Zanzibar archipelago, the Zanzibar leopard (Fig. 12.10) was not scientifically studied until the 1920s (Walsh and Goldman 2017), when a specimen was shot and sent to the British Museum (Pocock 1932). Leopards on this island population were smaller in size and had a different coat than all other known leopards. In particular, the rosettes appeared "disintegrated" in small points very close together (Pocock 1932).

Currently there are only six specimens stored in museums, all dating back to the British colonial period (Walsh and Goldman 2008), and its taxonomic status remains uncertain, given its exclusion from a recent review of the species on genetic basis (Miththapala et al. 1996; Uphyrkina et al. 2001).

Zanzibar leopard has never been studied in the wild, and very little is known from the literature of the time (e.g., Mansfield-Aders 1920). Although it was the largest carnivore on the island, nothing is known about its diet, but it is likely that Aders's duikers (*Cephalophus adersi*), blue duikers (*Philantomba monticola*), and sunis (*Neotragus moschatus*) were among its prey.

Its decline began in the first half of the nineteenth century with the large-scale transformation of the island's landscapes (Walsh and Goldman 2007).

The main cause of its extermination was due to the complex belief system developed by the natives to explain the increasing presence of leopards near inhabited areas. In fact, there was a widespread belief that the specimens sighted

Fig. 12.10 Stuffed Zanzibar leopard specimen in Zanzibar Natural History Museum. (Peter Maas)

far from the forests were bred by witches to cause harm to people (Walsh and Goldman 2017).

The locals urged the British protectorate to control the leopard population because of attacks on people and livestock, but despite the British government's efforts to prevent leopard hunting, rural communities continued to persecute them. The peak came after the Zanzibar Revolution in 1964, when the new government supported a national campaign of shootings (Walsh and Goldman 2017).

Interest in the fate of the leopard population arose only in the 1990s (e.g., Archer et al. 1991; Archer 1994). The Zanzibar leopard is generally considered extinct (e.g., Smithers 1971; Hes 1991; Miththapala et al. 1996; Nowell and Jackson 1996). In the 1980s two sightings were reported (Swai 1983), while the last documented shooting with material evidence seems to date back to 1986 (Walsh and Goldman 2008) and is proved by two fragments of skin (now lost) in the possession of the former Secretary of the Zanzibar National Hunters.

In 1997 and 2001, some rumors circulated about the discovery of alleged excrements, but in both cases the samples were lost before being properly analyzed (Walsh and Goldman 2008). In 2018 a crew of Animal Planet, during the recordings of a television program, obtained a camera trap video of an alleged Zanzibar leopard (Li 2018). Some authorities responsible for the Zanzibar leopard do not consider this film to be reliable evidence (H. Goldman pers. comm.; Goldman and Walsh 2018) and its diffusion on the internet has been restricted to the American television newsmagazine Inside Edition and some blogs devoted to paranormal and other alleged mysteries. On the other hand, the author has defended the authenticity of the film (F. Galante, pers. comm.). The video undoubtedly shows a leopard, but the images do not allow to verify precisely the pattern of the rosettes or to determine the shooting's locality. It should also be noted that a feral African leopard released in Zanzibar is an option which can be eliminated, but only DNA evidence (such as from scats) would offer an opportunity to differentiate this animal from other leopards. Although remaining skeptical, we hope that, given the potential importance for conservation, further investigation will deepen the matter.

12.5 Discussion

This review of case studies stressed how the direct impact of human can be lethal to the conservation of animal populations. Predators at the top of the trophic chain are the first to suffer the consequences of direct persecution and habitat alteration (e.g., Henke and Bryant 1999; Rodríguez-Lozano et al. 2015), and it is for this reason that we can consider them among the most "problematic" animal species, which need special attention and targeted conservationist approaches (Sergio et al. 2005). In the case of lions, Black et al. (2013) suggest that while prey species will decline, possibly to micro population size, predators can survive by switching to livestock, causing new problematics. This trend seems related also to the cases on tigers and leopards reviewed in our work. One of the key risks relating to predators on the

verge of extinction is the disappearance of species, subspecies, or populations before it is possible to investigate their taxonomic status and ecology (e.g., Spassov et al. 2016; Angelici et al. 2019).

From this point of view, an interesting case is represented by the population of leopards of the small island of Kangean (Indonesia). First reported by Hartert (1902), the only material evidence is represented by a part of the tail secured by G.C. Shortridge in 1908 (Pocock 1930) and by a skin and skull collected in January 1984 (van Helvoort et al. 1985). Currently nothing is known about the current numerical size of the population, its origin, and systematic identity although it would seem consistent with the Java leopard *Panthera pardus melas* G. Cuvier, 1809. Some authors have suggested that the Kangean leopard was smaller than the continental form (Iongh et al. 1982; Delsman 1951), but there are no studies carried out on the few samples available. Other authors hypothesize an introduction in the island of a hunting prey (van Helvoort et al. 1985; Long 2003).

A characteristic of many big cats, especially when populations are very small in number, is their high elusiveness, often helped by the habitats in which they live (see Burton et al. 2011). This can lead to prematurely declare a species as extinct, thus potentially creating serious conservation damage (see Collar 1998). The case studies of the Barbary lion, Caspian tiger, and Barbary leopard, which showed their existence for decades beyond their supposed extinction into the modern era of pro-active conservation, point out how they could have been recovered before their extinction. A current example is provided by the western lion, considered extinct in Ghana (Henschel et al. 2014), but recent reports from the Mole National Park seem to indicate the survival of a very small population that could prove strategic for conservation of the species in Ghana and neighboring countries (see Angelici et al. 2015; Angelici and Rossi 2017).

Reports of big cats years after their declared extinction are not uncommon (see Black et al. 2013), and the most recent concerns the Taiwanese clouded leopard *Neofelis nebulosa brachyura*. The last reliable data date back to 1986 (Rabinowitz 1988) and 1989 (Anonymous 1996). Then, apart from a dubious sighting in 1990 (Lue et al. 1992), subsequent surveys did not obtain results (Chiang 2007, Chiang et al. 2015). In 2013 the subspecies was officially declared extinct (Grassman et al. 2016), but in early 2019, independent sightings from Taitung County (Southeast of the island) were recorded (Hoffner 2019).

The history of the extinction and decline of these animals, in all cases, were caused by interactions with human, demonstrating the extreme fragility of ecosystems and the extreme difficulty in protecting endangered species. The fact that in many cases even legal protection has not been sufficient to help a species (see Zanzibar leopard) indicates that conservation strategies cannot only be carried on by governments and researchers and that local populations must be involved to play a role (e.g., Danielsen et al. 2007; Ocholla et al. 2016). It should be pointed out that in some cases even the application of very strict laws can be harmful. In North Africa, for example, following the killing of a leopard in the Bou Tferda region in 1983 by the locals, severe sanctions were issued. The news spread quickly in the region and locals stopped giving the researchers information about the leopard (Cuzin 2003).

12.6 Conclusion

We can summarize the main findings of our work in four principal points that can suggest actions to improve the conservation of micro populations of big cats:

- Locals are generally the last to report and to interact with relict predator populations, often due to attack on livestock. Measures to encourage locals to live with predators through virtuous practices aimed at making people understand the importance of these top predators for the entire ecosystem are thus essential. In 2010 in Kenya, through a program called "Warrior Watch", the Samburu warriors (once lion hunters) are working within their local communities to protect livestock and promote coexistence between people and lions (Gurd 2012).
- As in the case of Barbary lion in Morocco, top predators can survive in captivity after their eradication or extinction in nature. Ex situ conservation has proved useful for several big cats, such as the Chinese tiger (actually living only in captivity) and the Amur leopard *(Panthera pardus orientalis)*, which has an important population living in zoos, and this should be incentivized (e.g., Luo et al. 2008).
- Big cats can "reappear" unexpectedly even many years after their official disappearance. Research must be encouraged and the use of camera traps can be very effective, as in the case of the recent rediscovery of the lion in Gabon, formerly considered locally extinct since 2006 (Barnett et al. 2018).
- Habitat loss is the main cause of extinction processes. Protected areas must be established where there are none yet. Considering the large home range big cats need (Cushman et al. 2018; Paviolo et al. 2018), contiguous and transnational areas are important for the establishment of ecological corridors.

These hints can lead to new and feasible conservation strategies, especially when a population still exists but is so small as to be on the verge of total extinction (e.g., Tilson et al. 2004; Ahmad Zafir et al. 2011).

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